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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Fumio KOYAMA et al.

Application No.: 10/801,821 Examiner: Don Wong

Filed: March 17, 2004 Docket No.: 111587.01

For: SURFACE EMITTING SEMICONDUCTOR LASER AND MANUFACTURING METHOD THEREOF

SUBMISSION OF MISSING PAGE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Please add the attached page 31 to the Specification in Application No. 10/801,821, filed March 17, 2004. The attached page of this Divisional application does not represent new matter because the page corresponds to page 31 in the parent application (Application No. 10/026,637, filed December 27, 2001).

Respectfully submitted,

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the recesses in the second aspect, and the holes of the fourth aspect of the present invention. One hole 50a is formed, for example as shown in Fig. 3C, on the surface of the upper multilayer reflection film 22 corresponding to the center position of the square current injection region about 8 μm square and remaining four holes 50b to 50e are formed at the corners of the square current injection region, for example, at the positions of about 2 μm away from the hole 50a. Here, each of the holes 50a to 50e has a diameter of about 0.5 μm, for example, and a depth reaching the upper multilayer reflection film 22, for example, of about 0.5 μm. Of course, it is not intended to limit the present invention to these dimensions. In the case where these five holes 50a to 50 e are formed, as shown in Fig. 3B, four light emitting spots 60a to 60 d are obtained.

Finally, Au-Ge/Ni/Au is deposited on the bottom surface of the substrate as an n-side electrode 13 and is subjected to a heat treatment in a nitrogen atmosphere at 350°C for ten minutes to produce a surface emitting semiconductor laser of a configuration shown in Fig. 2H.

Here, optical output power-injection current (L-I) characteristics and a near-field image produced by the surface emitting semiconductor laser obtained in this manner will be shown in Fig. 4. An LP_{21} mode oscillation which is stable in all current injection region was obtained and the maximum optical output power was 3.5 mW and series resistance was 80 Ω at the optical output power of 3 mW. Here, in Fig. 4, the